Negative investment in China: financing constraints and restructuring versus growth

Sai Ding[+*]

(*University of Glasgow*)

Alessandra Guariglia

(*Durham University*)

and

John Knight

(*University of Oxford*)

Abstract

This paper attempts to address a puzzle in China's investment pattern: despite high aggregate investment and remarkable economic growth, negative net investment is commonly found at the microeconomic level. Using a large firm-level dataset, we test three hypotheses to explain the existence and extent of negative investment in each ownership group: what we term the efficiency (or restructuring) hypothesis, the (lack of) financing hypothesis, and the (slow) growth hypothesis. Our panel data probit estimations shows that negative investment by state-owned firms can be explained mainly by inefficiency: owing to over-investment or mis-investment in the past, these firms have had to restructure and to get rid of obsolete capital in the face of increasing competition and hardening budgets. The financing explanation holds for private firms, which have had to divest in order to raise capital. However, rapid economic growth weighs against both effects in all types of firms, with a larger impact for firms in the private and foreign sectors. A tobit model, estimated to examine the determinants of the amount of negative investment, yields similar conclusions.

JEL classification: G3; O16; O53

Keywords: Negative investment; Divestment; Industrial restructuring; Financial constraints; Economic transition; China

[+] *Corresponding author:* Sai Ding, Economics, Business School, Adam Smith Building, University of Glasgow, Glasgow, UK, G12 8RT. Email: sai.ding@glasgow.ac.uk.

*The authors thank the ESRC for providing financial support for this research (RES-000-22-3140). The research was conducted while Sai Ding was in the Department of Economics, University of Oxford. We are grateful to the participants the annual Chinese Economists Society (CES) conference held at Xiamen University in China; the annual conference of the UK Chinese Economic Association (CEA) held in Oxford; and the 3rd conference of the International Forum for Contemporary Chinese Studies held at Xi'an Jiao Tong University in China for helpful comments.

1. Introduction

China's investment rate during the last three decades has been remarkably high. Gross capital formation has averaged a fairly steady 39 percent of GDP over the entire reform period, the fixed capital formation component of which has risen, from an average of 29 percent between 1978 and 1992 to an average of 37 percent between 1993 and 2009[1]. The high investment rate and dramatic investment-generated improvements in productivity and technology have been viewed as the main driving forces behind China's remarkable growth over the reform period. Investment accounts for about two-thirds of the growth differences between China and Sub-Saharan Africa (Ding and Knight, 2009). It appears that high investment has been a necessary condition for China's remarkable growth success.

Nevertheless, China also has much negative net investment. Our comprehensive nationwide annual dataset of about 100,000 Chinese manufacturing firms covering the period 2000-07 shows that, on the one hand, annual net investment averaged 22% of value added and 10% of fixed capital stock but, on the other hand, 31% of the firm-year observations in the sample actually divested! The combination of high investment for firms in aggregate and divestment among individual firms presents a puzzle which, to our knowledge, has been ignored in the literature. In this paper we attempt to solve it.

China is not alone in having a high rate of negative investment. Using firm-level data from Amadeus (Bureau Van Dijk) and the same variable definition, we observe extensive divestment among many transition economies over similar time periods: 9% in Poland, 9% in the Czech Republic, 13% in Bulgaria, and 33% in Romania. Much negative investment can also be observed in the UK FAME dataset (Bureau Van Dijk), according to which 22% of firm-year observations are characterized by negative net investment. The phenomenon deserves to be understood, particularly in the case of China. On the one hand, China's fast economic growth should reduce the frequency of negative investment below that of slower-growing economies. On the other hand, the transitional and marketizing status of the Chinese economy should raise the frequency above that of market economies.

Using the firm-level dataset referred to above, we attempt to provide answers to two broad research questions. First, why do Chinese firms divest, i.e., what variables determine the probability of negative net investment? Second, why do some firms divest more than others, i.e., what are the determinants of the amount of negative investment among divesting firms? To answer these questions, probit and tobit models are respectively estimated. We find

[1] Data source: *World Development Indicators* (2010 version).

that state-owned enterprises (SOEs) divest mainly for inefficiency or restructuring reasons, e.g., they need to eliminate obsolete capital in the face of rising competition or other pressures to become efficient. Negative investment by private firms is mainly due to external financial constraints, e.g., they need to obtain funds before investing in new opportunities. The fact that firms are growing fast offsets both of these incentives for negative investment, particularly so in the case of the - most dynamic - private and foreign firms.

The remainder of the paper is organized as follows. Section 2 briefly reviews the relevant theories and empirical evidence on negative investment. Section 3 specifies and explains the hypotheses that we test against the background of China's institutional reform. Section 4 describes the data and sample, with a focus on the ownership definitions. Section 5 sets out our baseline specifications and empirical methodology. Section 6 reports the descriptive statistics and interprets the estimation results of both the probit and tobit models. Section 7 provides a number of robustness tests for each hypothesis. Section 8 draws conclusions.

2. Literature review

Compared with the enormous literature on positive investment by firms, the topic of negative investment (or divestment) is under-researched. Moreover, the negative investment literature focuses largely on developed countries characterized by mature financial markets. According to Gadad *et al*. (2004), divestment can take many forms: sell-off, spin-off, equity carve-out, and management buyout[2]. Given that most firms in our sample are not listed in the stock market, our survey focuses on the first form of divestment, the sell-off.

The finance literature has identified several reasons for negative investment, among which the following five are most prominent: the *efficiency* explanation, whereby assets are transferred to firms which can operate them more productively; the *focus* explanation, according to which divestment may permit concentration on core activities; the *financing* explanation, whereby divestment can raise capital without recourse to the capital market; the *liquidity* explanation, which stresses the need for assets to be liquid if divestment is to occur; and the *defensive restructuring* explanation, according to which asset divestment is a response to rapid economic transition. This explanation may well be intertwined with the

[2] A sell-off occurs when a firm sells a part of its assets to another firm. A spin-off takes place when ownership of the divested asset is transferred to a new company formed by a pro-rata distribution of equity shares in the new company to current shareholders. An equity carve-out occurs when ownership of the divested assets is transferred to a new company formed by the issue of equity shares in the new company to the public. A management buyout means that the incumbent management team buys all the equity shares of either a firm or a subsidiary from current shareholders.

efficiency explanation. Each of these hypotheses is potentially important for understanding the coexistence of widespread negative investment and huge positive investment among Chinese firms.

2.1 The efficiency explanation

Hite *et al*. (1987) argue that managers retain only assets for which they have a comparative advantage, and that they sell assets if another party can manage them more efficiently. Investigating cases for both partial or total sell-offs in the US[3], they find that asset sales are associated with the movement of resources to higher-valued uses and that sellers capture some of the resulting gains.

Using a US firm-level database, Maksimovic and Phillips (2001) analyze the market for corporate assets (plants, divisions, and whole firms) in manufacturing industries and examine how seller characteristics and firm organization influence asset sales. They find that assets are more likely to be sold when they are less productive than their industry benchmarks, when the selling division is less productive, when the selling firm has more productive divisions in other industries, and when the economy is undergoing positive demand shocks. The timing of sales and the pattern of efficiency gains suggest that divestments tend to improve the allocation of resources.

Warusawitharana (2008) presents a model in which asset sales and purchases enable the transfer of capital from less to more productive firms. His empirical analysis concludes that both return on assets and firm size influence asset transactions, i.e., more profitable firms purchase assets whereas less profitable firms choose to downsize and sell assets, and large firms engage more than small firms in asset transactions.

2.2 The focus explanation

John and Ofek (1995) emphasize focus as a motive for divestment: selling an unrelated asset leads to an increase in focus and to more efficient operation of the core business. The improvement in performance may have various causes, including elimination of negative synergies and better allocation of management time and other resources. Using a US sample, they find that asset sales improve the performance of the remaining assets in each of the three years following the asset sale, but only if the firm increases focus. The results support their hypothesis that divestments are undertaken to achieve a more focused operation.

[3] A partial sell-off is the sale of a subsidiary, division, or other operating assets; a total sell-off (or liquidation) occurs when a firm sells all its assets.

Berger and Ofek (1995) adopt segment-level US data to estimate the valuation effect of diversification and to examine the potential sources of value gains or losses. They find that the value of diversified firms is on average about 14% lower than the sum of the imputed values of their segments, implying that diversification reduces value. Overinvestment is associated with diversification, and segments of diversified firms overinvest more than single-line firms[4].

2.3 The financing explanation

Shleifer and Vishny (1992) link asset sales to the firm's debt capacity. They argue that selling assets can be more attractive and cheaper than debt rescheduling and issuing new securities as a way of raising funds to meet debt obligations. Asset sales can lessen conflicts between creditors, control agency costs, and alleviate the problem of informational asymmetry between the firm and outsiders. However, the process may be hindered if assets are illiquid.

Lang *et al*. (1995) argue that managers may sell assets to obtain funds when alternative funding is either more expensive or unavailable. Highly-leveraged or poorly-performing firms may find it expensive to use the capital markets owing to adverse selection costs (Myers and Majluf, 1984) or agency costs of managerial discretion (Jensen, 1988; Stulz, 1990). Based on a sample of US asset sales, Lang *et al.* (1995) find that firms selling assets are characterized by high leverage or poor performance. The typical firm selling assets appears to be motivated by its financial situation rather than by its comparative advantage.

Hovakimian and Titman (2006) examine the relationship between proceeds from voluntary asset sales and investment expenditure, using a US dataset. Their regressions show that cash obtained from asset sales is a significant determinant of corporate investment and that the sensitivity of investment to proceeds from asset sales is significantly stronger for firms that are likely to be financially constrained. Thus, funds from voluntary divestment provide an important financing source for financially constrained firms.

2.4 The liquidity explanation

Schlingemann *et al*. (2002) emphasize the role of asset liquidity in determining which asset is divested in the pursuit of firm objectives. They argue that more liquid assets are more likely to be divested. They control for the factors that initiate the divestment process by examining only focusing firms, i.e., firms cutting out segments. The probability that a segment is

[4] Overinvestment is defined as the sum of the depreciation-adjusted capital expenditures of all the segments of firms operating in industries whose Tobin's Q is in the lowest quartile of the distribution, scaled by total sales.

divested is found to be higher if the asset is in an industry with a liquid market for assets. Their empirical finding is in line with the theoretical prediction of Shleifer and Vishny (1992) that asset illiquidity impedes asset sales and worsens financial distress of firms.

2.5 The defensive restructuring explanation

Negative net investment can arise for different reasons in transition economies. Asset divestment can be forced on a firm when its survival is threatened. According to Carlin *et al*. (2001), divestment may indicate restructuring and downsizing by firms that have difficulties in adapting to a new market environment. Using a World Bank survey covering 25 transition countries, they examine the determinants of firm restructuring and performance. They find that SOEs and old firms are significantly more likely to engage in defensive restructuring through labour shedding and plant closures, and that firms with market power are less likely to do so.

This defensive restructuring argument is closely linked to the financing explanation for divestment proposed by Filatotchev *et al*. (2007). Using a survey of large private Hungarian and Polish companies, they investigate managers' choice of financing sources. Hypothesizing that divestment may be a means of raising funds if firms become financially distressed during economic transition, they find a negative relationship between divestment and bank finance. Their interpretation is that if firms are undergoing restructuring and seeking access to fresh finance, funders may view divestment as a negative signal and thus a deterrent to lending.

In summary, the literature provides various motivations for firms to divest. Asset sales enable financially healthy firms to restructure and to improve efficiency by selling assets to more productive users or by selling assets unrelated to the core business. Asset sales may permit financially constrained firms to raise capital if debt and equity markets are unattractive or unavailable. Asset liquidity plays a role in determining which assets are divested. In transition economies, asset divestment may assist defensive restructuring or relieve financial distress.

3. Development of hypotheses

Our hypotheses must take into account the Chinese context. China had a centrally planned economy until economic reform began in 1978. The reform process has been described by Deng Xiaoping as 'crossing the river by groping for the stones'. The reforms were incremental but hardly slow: huge changes have occurred in only three decades, as China has moved towards a market economy.

A distinguishing feature of China's institutional reform is the emergence of new forms of ownership. The Chinese industrial sector was initially dominated by SOEs, whose directive was to fulfil production quotas, to transfer profits to government, and to provide life-long employment. In the 1980s and early 1990s, the collectively-owned 'township and village enterprise' (TVE) sector grew rapidly and played a catalytic role in pushing China towards a market economy. Several factors contributed to the rapid development of TVEs, including planning restrictions on SOEs which created 'missing markets', their competitive advantage derived from low wages, and local government revenue incentives. Unlike SOEs, TVEs faced relatively hard budget constraints, so generating profit incentives. The entry of TVEs also provided competition for SOEs. However, when restrictions on the private sector were gradually relaxed and when the urban reforms created more incentives for SOEs to seek out profitable opportunities and to compete successfully against them, TVEs began to lose their ground; after the mid-1990s many were transformed into private businesses.

Deng Xiaoping's ‘southern tour’ of 1992 formally gave the green light to capitalist development. The Company Law adopted in 1994 provided a uniform legal framework into which all of the ownership forms fit, signalling the introduction of more clearly defined property rights and the start of the dramatic institutional change involved in the rapid downsizing of the state sector. Many SOEs and urban collective enterprises (UCEs) were shut down, and employment in SOEs and UCEs shrank by over 40 percent and 75 percent respectively between 1995 and 2006[5]. A large number of SOEs and UCEs were either privatized or turned into shareholding entities that are increasingly dominated by private owners (Lin and Zhu, 2001; Garnaut *et al*., 2005). However, SOEs remain dominant in energy, natural resources and a few strategic or monopolistic sectors that are controlled and protected by central and local governments.

Figure 1 shows the shares of different ownership categories in investment in fixed assets over the period of 1980-2008. SOEs accounted for the bulk of fixed investment until the early 1990s, after which the structure of investment altered dramatically. Between 1992 and 2008, the investment share of SOEs fell from two-thirds to one-third, whereas the share of private enterprises climbed to two-thirds. This has been viewed as a positive development, given that the average return on capital in SOEs was well below that in the private sector and many SOEs continued to make losses (Dougherty and Herd, 2005; Knight and Ding, 2010).

[5] Data source: *China Statistical Yearbook 2007*: 128.

There is evidence that the profitability of the state sector improved after 1998: the measures taken from the mid-1990s onwards to make SOEs more accountable for their profits and losses seem to have been effective (Lu *et al*., 2008; Knight and Ding, 2010). The SOEs that survived the massive downsizing and reform are assumed to be more efficient and profitable on average. Our comprehensive firm-level dataset, spanning the years from 2000 to 2007, provides an opportunity to test this argument. Our first hypothesis is that there are firms - SOEs in particular - which divest for efficiency reasons, i.e., some firms, being less efficient than others, choose to divest and downsize.

China's inefficient and 'repressed' financial system may cause firms ownership by different agents to behave differently. Government has intervened, and continues to intervene, in bank lending to favour the state sector (Riedel *et al*., 2007). Despite the gradual reform of the banking sector, bank loans constitute a major share of investment financing only for the SOEs, while private firms are generally discriminated against by the formal financial system and have to rely predominantly on internal funds for investment (Allen *et al*., 2005; Guariglia *et al*., forthcoming; Knight and Ding, 2010). Although these problems have become less severe since 2000 (Guariglia and Poncet, 2008), private investment has remained constrained (Haggard and Huang, 2008). Our second hypothesis is that there are firms - especially private firms - which divest in order to generate the funds required to pursue their objectives when other sources of finance are limited or costly.

A distinguishing feature of the Chinese economy is its rapid growth: the growth rate of GDP per capita averaged 8.6% per annum over the three decades of economic reform. Moreover, the growth of real sales in our sample averaged 11.6% per annum over the period 2000-07. This remarkable growth performance creates vast opportunities for investment. In the investment literature, Blomström *et al*. (1996) argue that growth induces subsequent capital formation more than capital formation induces subsequent growth. Thus our third hypothesis is that the growth of firms reduces both the probability of divestment and, if it occurs at all, the amount of divestment. The role of firm growth has not been explored in the literature on negative investment.

In summary, to understand why Chinese firms divest, we investigate how firm efficiency, financing, and growth influence negative investment in each ownership group. Our lack of segment-level data prevents a testing of the focus and liquidity hypotheses.

4. Data and sample

Firm-level data offer several advantages for the study of investment or divestment behaviour: the problem of aggregation over firms is eliminated in estimation, and the heterogeneity among various types of firms can be taken into account (Bond and Van Reenen, 2007). This is particularly important for China owing to the institutional differences between state and non-state enterprises.

We use data drawn from the annual accounting reports filed with the National Bureau of Statistics (NBS) by industrial firms over the period of 2000-07. The original sample contains more than 532,000 firms, including all SOEs and other types of enterprises with annual sales of five million yuan (about $650,000) or more. These firms operate in the manufacturing and mining sectors and in 31 provinces or province-equivalent municipal cities. We deleted observations with negative sales; as well as observations with negative total assets minus total fixed assets; total assets minus liquid assets; and accumulated depreciation minus current depreciation. Firms that lacked complete records on our main regression variables were also dropped. To control for the potential influence of outliers, we excluded observations in the one percent tails of each of the regression variables. Finally, we removed all firms with fewer than five years of consecutive observations.

Our final dataset covers 100,112 (mainly unlisted) firms, which yield 639,382 firm-year observations[6]. The sample is unbalanced: the structure of the panel can be seen in Table A1 in Appendix 1. The number of observations ranges from a minimum of 49,639 in 2000 to a maximum of 93,330 in 2003. Entry and exit of firms take place during our sample period: fewer than 30 percent of firms have the full 8-year accounting information. The active entry and exit of firms are the consequence of the enterprise restructuring that began in the mid-1990s, and can be viewed as a source of dynamism (see, for instance, Brandt *et al*., 2009).

The NBS data contain a continuous measure of ownership, which is based on the fraction of paid-in-capital contributed by six different types of investors: the state; foreign investors (excluding those from Hong Kong, Macao, and Taiwan); investors from Hong Kong, Macao, and Taiwan; legal entities; individuals; and collective investors. The rationale for dividing foreign investors into those from Hong Kong, Macao, and Taiwan, and those from other parts of the world is that the former capture the so-called 'round-tripping' foreign direct investment, whereby domestic firms may register as foreign invested firms from nearby regions to take advantage of the benefits (such as tax and legal benefits) granted to

[6] The NBS dataset does not allow separate identification of publicly listed companies. It is difficult to track these companies as their legal identification numbers were changed as they went public (Liu and Xiao, 2004). Over the period considered, there were slightly more than 1,000 listed companies operating in the manufacturing and mining sectors. This amounts to less than 0.3% of the total number of firms in our sample.

foreign invested firms (Huang, 2003). Ownership by legal entities, being a mixture of ownership by state legal entities and private legal entities[7], represents a form of corporate ownership. Collective firms are typically owned collectively by communities in rural areas (TVEs) or urban area (UCEs).

We group all foreign firms (from Hong Kong, Macao, Taiwan, and other parts of the world) into a single category (which are labelled foreign); and all firms owned by legal entities and individuals into a single category (labelled private)[8]. Thus our firms fall into four broad categories - state-owned, collective, private and foreign - based on the shares of paid-in-capital contributed by our four types of investors in each year.

We adopt two methods of classifying firms by ownership. First, we group firms according to the majority average ownership shares. For instance, if the average share of paid-in-capital owned by private investors over the period 2000-07 exceeds 50%, then the firm is classified as privately owned. A potential problem with this method is that the size of private ownership is likely to be exaggerated. According to Haggard and Huang (2008), genuinely private domestic firms are different from government-controlled firms. They argue that the former group has remained relatively small and subject to many controls and permissions, for instance with regard to the provision of finance and the requirement of official approval of investment projects above a certain size. To take this phenomenon into account, our second approach to classification is based on a 100% rule. In this case, a firm is classified, for instance, as privately-owned when all its paid-in-capital in every year is contributed by private investors. This method allows us to focus on the firms which are likely to represent the genuine private sector. The cost of this second approach is that many firms are left in a residual category, which is referred to as the mixed ownership group.

Table A2 in Appendix 1 reports the distribution of observations by ownership using both methods. Our sample is dominated by private firms, i.e., 62% firms are classified as privately-owned by the majority classification rule and 38% by the 100% rule. SOEs, collective firms and foreign firms represent 8%, 8% and 18% of our sample respectively using the majority rule, and 4%, 3% and 10% respectively using the 100% rule. The second

[7] Legal entities represent a mix of various domestic institutions, such as industrial enterprises, construction and real estate development companies, transportation and power companies, security companies, trust and investment companies, foundations and funds, banks, technology and research institutions etc.

[8] Within this category, firms owned by individuals represent about two thirds of the total. As firms owned by legal entities include firms owned by state legal entities, one could question their inclusion in the *private* category. One reason for including them is that while the state's primary interests is partly political (i.e. aimed at maintaining employment levels or control over certain strategic industries), legal entities are profit-oriented (Wei *et al*., 2005). Since our dataset does not allow us to discriminate between state and non-state legal persons, we are unable to exclude the former from our *private* category. However, our results are robust to excluding all firms owned by legal entities from the *private* category.

approach decreases the number of firms in all four types of ownership groups, and enlarges the mixed ownership group: 46% of our observations are classified as mixed ownership. Because the composition of investors in this residual group is unclear, the second method of ownership classification involves a significant loss of useful observations despite its potentially more accurate measure of private ownership. We therefore rely mainly on the majority classification rule to divide firms into different ownership groups, and use the 100% rule as a robustness check.

Table A2 in Appendix 1 shows an interesting pattern in the evolution of ownership over the period 2000-07. Based on the majority classification rule, we see that the proportion of SOEs in our sample declined dramatically from 12% in 2000 to 5% in 2007. A similar pattern holds for collective firms, whose share declined from 11% in 2000 to 7% in 2007. In contrast, the share of private firms rose from 52% to 66%, and that of foreign firms remained stable at 17-19%. Privatization of small SOEs and TVEs became significant after 1998 (Haggard and Huang, 2008), and our data reflect this restructuring process.

5. Baseline specification and estimation methodology

5.1 Baseline specification

We start by estimating the following regression

$$\begin{aligned} divestment_{i,t} = {} & \alpha_0 + \alpha_1 cash\,flow_{i,t-1} + \alpha_2 leverage_{i,t-1} + \alpha_3 collateral_{i,t-1} + \alpha_4 TFP_{i,t-1} \\ & + \alpha_5 sales\ growth_{i,t-1} + \alpha_6 firm\ size_{i,t-1} + \alpha_7 firm\ age_{i,t} + \alpha_8 export_{i,t} \\ & + v_t + v_j + v_{tj} + \varepsilon_{i,t}\ , \end{aligned} \tag{1}$$

where the dependent variable is a variable representing divestment. Unlike other studies in the literature, our dataset does not have any information on asset sales. We therefore define net investment as real tangible fixed assets in period *t* minus real tangible fixed assets in period *t-1*, net of depreciation, i.e., $I_t = K_t - (1-\delta)K_{t-1}$, where δ is the reported depreciation rate and K_t is the real value of tangible fixed assets in period t[9]. Negative investment or divestment occurs when $I_t < 0$.

When testing for the probability of negative investment, the dependent variable is a binary variable taking value of one if the firm divests, and zero otherwise. When examining the determinants of the amount of negative investment, the dependent variable is a censored variable which is equal to zero if the firm does not divest, and takes the value of the actual amount of divestment otherwise.

[9] Definitions of all variables are presented in Table A3 in Appendix 1.

The independent variables in equation (1) include proxies aimed at testing the financing, efficiency, and growth hypotheses, as well as some conditioning variables. $cash\ flow_{i,t-1}$ is the lagged cash flow to tangible fixed assets ratio, where cash flow is defined as the sum of net income and depreciation. Models of capital market imperfection imply that external financing is more costly than internal financing (for instance, Myers, 1984; Hubbard, 1998). For given levels of investment opportunities, information costs, and market interest rates, firms with higher net worth should invest more, and therefore have a lower probability, or lower amount, of negative investment. We hypothesize a negative coefficient on the cash flow term in the divestment equations.

Cash flow, however, is an imperfect proxy for changes in net worth, as it might also contain information about expected future profitability or, more in general, demand factors, which may be relevant to investment decisions even in the absence of capital market imperfections. This is especially the case when investment opportunities are omitted or mis-measured by standard measures such as Tobin's Q (Bond *et al.*, 2003; Carpenter and Guariglia, 2008). Thus the finding of a significant coefficient on cash flow cannot be interpreted as necessarily indicating financial constraints (Kaplan and Zingales, 1997; 2000). To deal with this problem, we adopt a method proposed by Brown and Peterson (2009), according to which interactions of time dummies and industry dummies are used to capture investment opportunities or, more specifically, time-varying demand shocks at the industry level. This method has been widely used in recent literature (see, for instance, Brown *et al*, 2009; Duchin *et al*., 2010; and Guariglia *et al*., forthcoming)[10].

The second financial variable, $leverage_{i,t-1}$, is the lagged ratio of total debt over total assets, and can be seen as a measure of the amount of external finance used by the firm. Leverage can affect investment in a number of ways. High leverage can impair a firm's ability to raise additional capital and reduce the amount of cash that is available for investment. According to Myers (1977), managers of highly leveraged firms may be induced to forgo positive net present value (NPV) projects because some or all of the benefits from the investment may accrue to debt-holders. Jensen (1986) and Stulz (1990) argue that high leverage in low-growth firms discourages management from undertaking unprofitable investments. These theories predict a negative relationship between leverage and investment. Consequently, the probability or amount of negative investment may rise with a higher leverage ratio. On the other hand, high leverage might also be interpreted as indicating high

[10] As most of the firms in our dataset are unlisted, we are unable to calculate Tobin's Q.

debt capacity or low external financial constraints (Hovakimian, 2009). In these circumstances, there may be a positive relationship between leverage and investment, and thus the probability, or the amount, of negative investment may decrease as leverage increases.

Most empirical literature supports the former view. For instance, using US or Canadian data, Lang *et al*. (1996), Aivazian *et al*. (2005) and Ahn *et al*. (2006) all report a negative relation between investment and leverage and that the correlation is much stronger for firms with low growth. Firth *et al*. (2008) obtain a negative relationship between leverage and investment among listed firms in China, and find that the connection is weaker in firms with low growth opportunities, poor operating performance, and high level of state shareholding. They claim that this is consistent with the hypothesis that state-owned banks in China impose fewer restrictions on the capital expenditures of low growth and poorly performing firms, as well as firms with greater state ownership. We expect the relationship between leverage and divestment to be positive for SOEs as a result of their soft budget constraints, but negative for private firms which have limited access to formal bank credit and may have to divest for financing purpose.

The third financial variable, $collateral_{i,t-1}$, is a measure of asset tangibility, defined as the lagged ratio of tangible fixed assets to total assets. Collateral can be important in raising funds in the presence of incentive problems and asymmetric information between the firm and the capital market (Wette, 1983). Firms with lower tangibility of assets are more likely to have difficulties in borrowing and thus to have to cut back on investment. On the other hand, Hovakimian (2009) argues that firms with low asset tangibility are more likely to operate in industries with high growth, and could therefore display higher investment. We therefore keep an open mind about the sign of the coefficient associated with collateral.

To test the efficiency hypothesis, we compute the firm-level total factor productivity ($TFP_{i,t-1}$) using the Levinsohn and Petrin (2003) method, which is described in Appendix 2. Similar to the three financing variables, we lag our TFP measure once to alleviate the potential endogeneity problem in the divestment regressions. We predict a negative relationship between firm-level TFP and divestment based on the efficiency explanation. We also expect the effect to be greatest for the SOEs, which are much less efficient than other non-state firms.

The lagged growth rates of real sales, $sales\ growth_{i,t-1}$, a proxy for output growth of the firm, is used to test for the growth hypothesis of divestment. We hypothesize a negative relationship between sales growth and negative investment. We also expect the effect to be greater for non-state firms than for SOEs given the widespread evidence that the former are much more dynamic than the latter.

As for the control variables, we include firm size, firm age and an export dummy in our baseline model. $firm\ size_{i,t-1}$ is defined as the lagged value of the natural logarithm of real total assets. It can be important in explaining financing choices for corporate investment. According to Myers and Majluf (1984), size may serve as an inverse proxy for the extent of informational asymmetries between the firm's insiders and external finance providers: smaller firms are expected to face higher hurdles when raising external capital, whereas large firms, which are assumed to be more diversified and less prone to bankruptcy, can borrow more easily. We hypothesize that firm size does not play an important role in SOEs' divestment decisions owing to their soft budget constraints, but might be important for non-state firms.

Firm age may also serve as a proxy for the wedge between the costs of external and internal capital (Oliner and Rudebusch, 1992). On the one hand, younger firms are more likely to face problems of asymmetric information and may therefore be more financially constrained compared to their older counterparts. On the other hand, younger firms are generally more dynamic and efficient than old ones. In the Chinese context, old firms may be less efficient and more likely to divest for restructuring reasons, whereas younger firms may be more likely to divest for funding reasons.

We use an export dummy to capture the expected performance-enhancing efforts of export activities among Chinese firms. We hypothesize that firms conducting export business are more likely not to divest or to divest less. This is consistent with widespread evidence that efficiency and exports are positively correlated in China (Kraay, 1999; Park *et al.*, forthcoming).

Lastly, we include time dummies (v_t) to account for macroeconomic fluctuations or business cycle effects, industry dummies (v_j) to capture industry-specific effects, and the interactions of time and industry dummies (v_{tj}) to account for industry-specific shifts in investment demand or expectations.

5.2 Estimation methodology

We first estimate a random-effects probit model to examine the factors that determine the probability of negative investment for each ownership group. We then use a random-effects tobit model to estimate the determinants of the amount of negative investment in the divesting firms.

To control for the potential endogeneity of our regressors, all variables except firm age and dummies are lagged once in our regression, the aim being to alleviate simultaneity bias. As a robustness test, we also estimate our equations using an Instrumental Variable (IV) approach.

6. Empirical results

6.1 Descriptive statistics

Table 1 presents descriptive statistics for some key variables. Fixed asset investment as a proportion of tangible fixed assets averages 9.5% in our sample. The rate is lowest for SOEs (4.2%) and highest for private firms (10.7%), followed by foreign firms (9.9%). The proportion of firms that have negative fixed asset investment is 31.4% for the full sample: it is highest for SOEs (40.7%) and lowest for foreign firms (29.1%) and private firms (30.3%). Negative investment is a widespread phenomenon in all types of firms in China. The high proportion in the case of SOEs suggests that there may be dramatic structural changes in this sector.

Turning to the three financial variables included in our baseline model: SOEs have the lowest cash flow ratio (14.1%), and the highest leverage (63.2%) and asset tangibility ratios (41.5%). In contrast, foreign firms have the lowest leverage (48.5%) and asset tangibility ratios (32.3%). The ratios of private firms lie between those of SOEs and foreign firms. Collective firms have the highest cash flow (41.5%). The co-existence of high leverage and low cash flow in the state sector is initial evidence of the easy credit and soft budget constraints enjoyed by SOEs. The descriptive statistics for collective firms are consistent with Naughton's (2007) view that, after reform and transformation, these firms operate effectively as private enterprises.

SOEs have the lowest TFP and foreign firms the highest, followed by private firms and then collective firms. It is apparent that SOEs remain the least efficient. SOEs also have the lowest rate of sales growth (6.0%), whereas private firms have the highest rate (13.1%). Foreign firms also have a high growth rate (11.2%). The growth rate of collective firms (8.3%) is higher than SOEs' but lower than that of private and foreign firms. Thus private and foreign firms are the faster growing groups, whereas SOEs are, relatively speaking, stagnating.

SOEs are generally older and larger than enterprises in the non-state sectors. Collective firms and SOEs are least involved in the exporting business: respectively only 14.4%

and 18.1% of these firms export, compared to 71.5% and 27.6%, respecively for foreign and private firms.

In summary, the descriptive statistics show that over the period 2000-07, SOEs were the least financially healthy, the least efficient and the slowest growing. Given their easy access to credit, reflected in their high leverage ratio, the poor performance of SOEs reflects inefficiencies in capital allocation and a sluggish response to market forces. It is therefore not surprising to observe that SOEs had the highest negative investment rate. In contrast, private and foreign firms were the most profitable, efficient, and dynamic sectors. Collective firms had good financial performance but fewer growth opportunities. These differences make it plausible to hypothesize that different ownership groups divest for different reasons. In the sub-section that follows, we aim to test whether this is indeed the case.

6.2 Random-effects probit results

Table 2 reports random-effects probit estimates of our baseline model. The cash flow coefficient is negative and significant for all four ownership groups, which accords with the theoretical prediction that firms with higher net worth will divest less. The divestment rate of SOEs is more sensitive to the availability of internal finance than that of firms in non-state sectors. A unit standard deviation decrease in the cash flow ratio increases the probability of negative investment by 7.9% for SOEs, 3.8% for private firms, and 2.6% for foreign firms.

The leverage ratio displays an interesting pattern across the ownership groups. The coefficient is significantly positive for SOEs, significantly negative for private firms, and insignificant for collective and foreign firms. For SOEs, the probability of negative investment is higher the higher the level of external borrowing: a one standard deviation increase in the leverage ratio is associated with an increase in the probability of divestment of 5.2 percentage points. Taking into account the fact that SOEs have the highest leverage ratio, we see the adverse effect of easy credit and soft budget constraints: excess leverage seems to impair SOEs' investment capability. On the contrary, private firms are more likely to divest the lower the leverage ratio: the probability of having negative investment rises by 5.8 percentage points in the presence of a unit standard deviation decrease in the leverage ratio. Private firms are generally discriminated against by the domestic banking system and have to rely on internal sources of finance such as retained earnings or asset sales to raise capital. These findings support the hypothesis that the financing explanation of negative investment holds for them, and are consistent with the recent literature on corporate finance in China (Haggard and Huang, 2008; Guariglia *et al*., forthcoming). External finance does not affect the divestment decisions of collective and foreign firms, perhaps because of their links with local governments and international financial markets respectively. These may serve as alternative sources of finance for them.

The coefficient on the collateral ratio is positive and significant for all firms: a higher asset tangibility ratio is associated with a higher probability of negative investment. This result does not support the idea that collateral plays a role in alleviating information asymmetries between firms and creditors and thus fostering investment. This is not surprising for China given its underdeveloped and repressed financial system. Rather, our data are in line with the view of Hovakimian (2009) that firms with lower asset tangibility are more likely to operate in industries with higher growth opportunities so that the probability of negative investment declines as asset tangibility falls.

The firm-level TFP measure has a significantly negative coefficient for all ownership groups: firms are more likely to divest when they are less productive. The marginal effect is greatest for SOEs: a unit standard deviation increase in TFP reduces the probability of negative investment by 2 percentage points for SOEs, 1.4 percentage points for collective firms, 1.1 percentage points for private firms, and 0.6 percentage points for foreign firms. The efficiency argument thus provides a good explanation for the negative investment in the state sector: owing to over-investment or mis-investment in the past, SOEs divest in order to eliminate obsolete capital in the face of increasing competition and other incentives to make profits and avoid losses.

The growth rate of real sales significantly reduces the probability of divestment for all types of firms, with the largest marginal effects for private and foreign firms: in the presence of a unit standard deviation increase in sales growth, the probability of negative investment drops by 9 and 10 percentage points respectively for these two groups of firms. This supports our hypothesis that firm growth protects against negative investment. In their divestment decisions, private and foreign firms are more responsive to growth opportunities than state and collective firms.

Turning to the control variables: the coefficient on firm size is insignificant for the divestment decisions of SOEs and foreign firms, but it is significantly positive for collective and private firms. This is consistent with our prediction that their easy access to external finance insulates the divestment decisions of SOEs from the influences of firm size. Smaller collective and private firms are more likely to outperform their larger counterparts, and therefore are less likely to divest.

The coefficient of firm age is positive and significant in the divestment regression for all firms. In China firm age does not perform an efficient role in alleviating informational asymmetry, as it does in many developed financial markets. Instead, younger firms, being generally more dynamic and efficient, are less likely to divest.

The export dummy is insignificant for SOEs and collective firms but significantly negative for private and foreign firms. The probability of negative investment declines when private and foreign firms have the opportunity to export. The marginal effects imply that exporters in the two groups have a 4-5% lower probability of divestment than non-exporters. This is in line with the view of Park *et al.* (forthcoming) that exporting is a cause of superior performance.

In summary, our probit results suggest that negative investment can be mainly explained by inefficiency in the case of SOEs and by financial constraints in the case of private firms. Rapid growth of the firm counterweighs both effects for all types of firms. Moreover, a high probability of negative investment in the non-state sectors is associated with certain firm characteristics: being old, large, and lacking access to overseas markets.

6.3 Random-effects tobit results

For those firms which divest, what factors determine the amount of negative investment? To answer this question, equation (1) is estimated using a tobit model. The results are shown in Table 3.

In line with the findings in the probit model, lower cash flow and higher asset tangibility are associated with a higher level of negative investment for all firms. The leverage term is significantly negative for collective and private firms, but insignificant for SOEs and foreign firms. The biggest effect is found for private firms: for these, a unit standard deviation decrease in the leverage ratio raises the amount of negative investment by 12.6%. The finding that lower levels of external finance produce more divestment confirms our hypothesis that the need for funds may explain divestment by private firms.

The coefficient of TFP is significantly negative for all firms, with the biggest effect for SOEs: for these firms, a unit standard deviation decrease in TFP raises the amount of negative investment by 1.9%. This is consistent with our prediction that inefficiency is most important in explaining the massive divestment in the state sector.

The growth rate of sales also has a negative and significant coefficient for all firms: a higher sales growth is associated with less divestment. Bigger marginal effects are found for private and foreign firms: a one standard deviation rise in sales growth decreases the amount of negative investment by 11.8% and 13.6% respectively for these two groups of firms. This suggests that the growth hypothesis holds most for the fastest-growing sectors.

Several additional factors affect the amount of negative investment in the non-state firms. For instance, larger and older firms, and those which do not export, tend to have more negative investment. Overall the findings are consistent with our probit results.

7. Robustness tests

7.1 Alternative tests of the hypotheses

To test the robustness of our results in the baseline model, we use some alternative measures of our main right hand side variables. We first introduce a measure of net profit to proxy firms' net worth. One important component of the cash flow measure is depreciation. However there is no consensus as to whether depreciation is a source of funds, i.e., whether depreciation is a source of capital replacement or just one of the adjustments needed to convert the accrual net income to the cash provided from operating activities. As a robustness check, we deduct deprecation from cash flow, which gives a measure of net profit. The new model with the net profit ratio is specified as follows.

$$\begin{aligned} divestment_{i,t} = {} & \alpha_0 + \alpha_1 net\,profit_{i,t-1} + \alpha_2 leverage_{i,t-1} + \alpha_3 collateral_{i,t-1} + \alpha_4 TFP_{i,t-1} \\ & + \alpha_5 sales\ growth_{i,t-1} + \alpha_6 firm\ size_{i,t-1} + \alpha_7 firm\ age_{i,t} + \alpha_8 export_{i,t} \\ & + v_t + v_j + v_{tj} + \varepsilon_{i,t}\ , \end{aligned} \tag{2}$$

where $net\ profit_{i,t-1}$ is defined as lagged net income divided by total tangible fixed assets.

We also compute two widely-used proxies for firm-level productivity. First, following McGuckin and Nguyen (1995) and Maksimovic and Phillips (2001), we calculate value added per worker, $value\ added\ per\ worker_{i,t-1}$, which is defined as the lagged value of total sales less materials cost of goods sold, divided by the number of workers. Second, we construct the average labour productivity, $productivity_{i,t-1}$, which is given by the lagged total real sales divided by the number of workers. Neither of these measures has the desirable theoretical properties of TFP, but they may have desirable statistical properties since they are not computed from a regression. The model with these two alternative efficiency measures is as follows:

$$\begin{aligned} divestment_{i,t} = {} & \alpha_0 + \alpha_1 cash\ flow_{i,t-1} + \alpha_2 leverage_{i,t-1} + \alpha_3 collateral_{i,t-1} \\ & + \alpha_4 value\ added\ per\ worker_{i,t-1}\ or\ productivity_{i,t-1} + \alpha_5 sales\ growth_{i,t-1} \\ & + \alpha_6 firm\ size_{i,t-1} + \alpha_7 firm\ age_{i,t} + \alpha_8 export_{i,t} + v_t + v_j + v_{tj} + \varepsilon_{i,t}. \end{aligned} \tag{3}$$

To test the robustness of the growth hypothesis, we include different measures of growth. The first is the growth rate of value added ($value\ added\ growth_{i,t-1}$). We are also interested in various sources of output growth, i.e., the rate of factor accumulation (proxied by the growth rates of total assets, $asset\ growth_{i,t-1}$, and of employment, $employment\ growth_{i,t-1}$), and the rate of improvement in firm productivity (the growth rate of TFP, $TFP\ growth_{i,t-1}$). The model with these alternative growth variables can be expressed as follows:

$$\begin{aligned} divestment_{i,t} = {} & \alpha_0 + \alpha_1 cash\ flow_{i,t-1} + \alpha_2 leverage_{i,t-1} + \alpha_3 collateral_{i,t-1} + \alpha_4 TFP_{i,t-1} \\ & + \alpha_5 value\ added\ growth_{i,t-1} or\ asset\ growth_{i,t-1}\ or\ employment\ growth_{i,t-1} \\ & or\ TFP\ growth_{i,t-1} + \alpha_6 firm\ size_{i,t-1} + \alpha_7 firm\ age_{i,t} + \alpha_8 export_{i,t} \\ & + v_t + v_j + v_{tj} + \varepsilon_{i,t}\ . \end{aligned} \tag{4}$$

Lastly, we include the exports to sales ratio as a control variable in the regression, in place of the dummy variable indicating whether or not the firm exports. This leads to the following model:

$$\begin{aligned} divestment_{i,t} = {} & \alpha_0 + \alpha_1 cash\ flow_{i,t-1} + \alpha_2 leverage_{i,t-1} + \alpha_3 collateral_{i,t-1} + \alpha_4 TFP_{i,t-1} \\ & + \alpha_5 sales\ growth_{i,t-1} + \alpha_6 firm\ size_{i,t-1} + \alpha_7 firm\ age_{i,t} \\ & + \alpha_8 export\ ratio_{i,t-1} + v_t + v_j + v_{tj} + \varepsilon_{i,t}\ , \end{aligned} \tag{5}$$

where $export\ ratio_{i,t-1}$ is the lagged ratio of exports to total real sales.

We present summary statistics of these new variables in Table 4. The net profit ratio is lowest for SOEs (5.9%), whereas for all non-state sectors, it is above 24%. There is a sharp contrast in profitability between the state and non-state firms. SOEs have the lowest efficiency as measured by value added per worker and average labour productivity, and private and foreign firms are the most efficient. SOEs also have the lowest rates of all four growth measures, i.e., value added growth (3.6%), total asset growth (1.7%), employment growth (-4.1%), and TFP growth (4.4%). On the other hand, private firms have the highest growth rates of value added (12.6%), total assets (10.6%), and TFP (9.8%). Foreign firms have the highest growth in employment (4.9%). SOEs have the lowest exports to sales ratio (4.5%), while foreign firms have the highest (49.5%). The ratios for collective firms and private firms are in between. In brief, these statistics confirm our previous findings that SOEs are the worst performers in terms of profitability, efficiency, growth and exports, whereas private and foreign firms are the best performers.

Table 5 reports the probit estimation results for the models including these new variables. Net profit displays a very similar pattern to that of cash flow: the probability of divestment declines as internal finance becomes abundant and the marginal effect is greatest for SOEs. The presence of the profit ratio variable does not change the features of the leverage term (not reported): excess leverage in the state sector still worsens firms' performance and increases the probability of negative investment, whereas, for private firms, limited access to external finance creates incentives for divestment.

The coefficient on value added per worker is significantly negative for SOEs, insignificant for collective firms, and significantly positive for private and foreign firms. This indicates, more clearly than in the baseline model that the efficiency explanation of negative investment holds only for the state sector: for SOEs, a one standard deviation decrease in value added per worker is associated with an increase in the probability of divestment by 2.3 percentage points. For private and foreign firms, the probability of negative investment increases as efficiency improves, implying that it is not because they are inefficient that they divest. The use of average labour productivity tells the same story, except that collective firms also have a significantly positive coefficient. Thus these robustness tests not only confirm that the efficiency explanation applies to SOEs but also provide evidence that it does not apply to non-state firms.

Growth of value added and TFP do not affect the divestment decisions of state and collective firms but reduce the probability of divestment by private and foreign firms. In the case of real asset growth and employment growth, the coefficient is significantly negative for all firms. Although there are minor differences according to the measure being used, our main finding of the growth explanation is robust: growth generally reduces the chances of negative investment, but tends to do so more for private and foreign firms than for state and collective firms.

We find that the baseline results for the control variables are robust when alternative measures are used. Moreover, our results also hold when we use the 100% rule to classify ownership groups and when the tobit estimation method is employed. To save space we do not report these results.

7.2 Instrumental variable methods

Our method of lagging the right-hand-side variables once might not be sufficient to alleviate potential endogeneity. As a further robustness test, we therefore use the instrumental variable (IV) method to test our baseline model specification. We instrument all financing, efficiency, growth and firm size variables using their own values lagged twice. Both random-effects probit and tobit IV models are estimated. To save space, we only report the results of the probit estimation in Table 6.

The results relative to the variables representing our three hypotheses are generally consistent with those of our baseline model. One minor difference lies in the control variables of firm age and size. After being instrumented, the coefficient of firm size becomes significantly positive only for private firms, suggesting that firm size is not important in determining the divestment decisions of the other types of firms. A similar story holds for firm age, which is significant and positive only for private and foreign firms (a one standard deviation increase in firm age is associated with an increase in the probability of divestment by 7.3 and 13.8 percentage points for private and foreign firms respectively). These results strengthen our argument that the easy access of SOEs to external finance makes size and age irrelevant to their divestment decisions. Only in the private and foreign categories are younger and smaller firms more likely to outperform their counterparts, and therefore less likely to divest. In brief, the instrumental variable results provide evidence that the baseline model findings are robust.

7.3 Interaction terms

This section aims at testing the possibility that the response of negative investment to changes in certain variables may be non-linear. For instance, we found that in the baseline model, the relationship between cash flow and divestment is negative for all firms. A follow-up question is whether the impact is the same between firms with abundant cash flow and firms with scarce cash flow. We test for this hypothesis by estimating the following model:

$$\begin{aligned} divestment_{i,t} = {} & \alpha_0 + \alpha_1 cash\,flow_{i,t-1} * LOWCF_{i,t-1} + \alpha_2 cash\,flow_{i,t-1} * HIGHCF_{i,t-1} \\ & + \alpha_3 leverage_{i,t-1} + \alpha_4 collateral_{i,t-1} + \alpha_5 TFP_{i,t-1} + \alpha_6 sales\,growth_{i,t-1} \\ & + \alpha_7 firm\,size_{i,t-1} + \alpha_8 firm\,age_{i,t} + \alpha_9 export_{i,t} + v_t + v_j + v_{tj} + \varepsilon_{i,t}\,, \quad (6) \end{aligned}$$

where $LOWCF_{i,t-1}$ ($HIGHCF_{i,t-1}$) is a dummy variable equal to 1 if firm *i*'s cash flow at time *t-1* is in the bottom (top) half of the distribution of the cash flow of all firm-year observations in that same year, and 0 otherwise. Similarly, we compute interaction terms for leverage, collateral, TFP, and sales growth to examine the differential effects of these variables on the divestment decisions of firms with low/high leverage, low/high collateral, low/high TFP, and low/high sales growth, respectively.

Table 7 reports the probit estimation results of the models which include these interactions terms. To save space, we report only the results of the new interactions terms and a χ^2 test for the equality of the coefficients between each group of firms. We find that the impact of cash flow on negative investment is greater for firms with lower cash flow, and the difference between low and high cash flow groups is significant for SOEs, collective and private firms. Within these ownership groups, *ceteris paribus*, the sensitivity of the probability of divestment to changes in cash flow is higher for firms with lower cash flow. This can be explained considering that for firms with abundant cash flow, the latter typically carries a low marginal valuation: further adding to it does not therefore affect firm behaviour too much.

A significant difference between lower and higher leverage groups is found only for private firms. For these, an increase in leverage is associated with a drop in the probability of negative investment, the effect being greater for firms with lower external borrowing. Once again this can be explained considering that for firms with high leverage, leverage has a low marginal valuation: adding to it has consequently moderate effects. On the contrary, the coefficient on leverage is positive and significant for SOEs with higher leverage ratio: the adverse impact of soft budget constraint is, understandably, more severe for the state firms with high leverage.

The differential effect of asset tangibility on divestment between low and high collateral groups is significant for all firms. For each ownership group, low asset tangibility is associated with a low probability of negative investment, the effect being greater for firms with a lower collateral ratio.

TFP displays an interesting pattern between low and high TFP groups. For SOEs and collective firms, the coefficient is negative and significant for firms with high TFP. State and collective firms divest for efficiency reasons, and this is particularly true for firms with relatively high TFP. In contrast, among private and foreign firms, the coefficient of TFP is significantly positive for firms in the low TFP group, i.e., private and foreign firms with low TFP do not divest for efficiency purpose, while private and foreign firms with high TFP do.

Lastly, for all ownership groups, the impact of sales growth on divestment is greater for firms with high growth rates. Growth reduces the chances of negative investment, and this is particularly the case for firms with high growth rates. This result helps to explain why divestment is more sensitive to growth for foreign and private firms: these are the faster growing ownership sectors.

In summary, all these robustness tests provide further support for our findings in the baseline model.

8. Conclusions

To the best of our knowledge, this paper represents a first attempt to investigate firms' divestment behaviour in China. The issue is of particular interest because it presents a puzzle. China is an international outlier on account of its high rate of industrial investment, but it is also characterized by a high frequency of negative net investment in its industrial sector. We have tried to explain this puzzle using a large and comprehensive panel data set of industrial firms over the period 2000-07.

Our descriptive statistics show dramatic structural changes over the decade, with the share of the state sector declining and that of the non-state sector expanding. Despite their gradual reform, SOEs remain the poor performers of the economy: they have the highest divestment rate, lowest profitability, lowest efficiency, slowest growth rate, and the highest leverage rate. This suggests that the state sector has been cushioned by favourable access to credit and state subsidies. In contrast, the private and foreign sectors, which contain the most efficient, profitable, and fast-growing firms, have less access to the formal financial system. Collective firms exhibit good financial performance and improvements in productivity, but their growth prospects are not comparable to those of private and foreign firms.

Given this huge heterogeneity in firms owned by different agents, our study of divestment in China required separate analysis of the different ownership groups. We tested whether firms owned by different agents divest for different reasons. The results from both our probit and tobit regressions support the hypothesis that the negative investment by SOEs can be explained largely by inefficiency, whereas private and foreign firms divest in order to raise capital. Rapid economic growth counterweighs both effects, especially in the private and foreign sectors, which are the most dynamic. Robustness tests using additional proxies, instrumental variables, and interactions terms support these findings.

Our findings have policy implications. For instance, the limited access to external finance of the non-state sector is the most likely source of negative investment for private firms. This suggests the need for further reform of the financial system, which has lagged behind most other economic reforms in China.

Our study suffers from a number of limitations. The dataset does not allow us to observe the exact timing and amount of asset sales or divestment by firms, making interpretations difficult. The extent to which our findings can be generalized to all sectors of the Chinese economy may also be questioned, due to the fact that only manufacturing and mining enterprises are covered in the NBS dataset. In order to test whether our findings can be generalized, future research should be extended to less mature, faster growing sectors of the economy such as the dynamic service sector, which has fuelled China's economic growth over the last few years. Finally, the lack of segment-level data makes it impossible to test other hypotheses of divestment such as the focus explanation and liquidity explanation, which may be important in determining firms' divestment behaviour.

References

Ahn, S., Denis, D. J., and Denis, D. K. (2006). Leverage and Investment in Diversified Firms. *Journal of Financial Economics , 79*, 317-337.

Aivazian, V., Ge, Y., and Qiu, J. (2005). The Impact of Leverage on Firm Investment: Canadian Evidence. *Journal of Corporate Finance , 11*, 277-291.

Alexander, G. J., Benson, G. P., and Kampmeyer, J. M. (1984). Investigating the Valuation Effects of Announcements of Voluntary Corporate Selloffs. *Journal of Finance , 39* (2), 503-517.

Allen, F., Qian, J. and M. Qian. (2005). Law, Finance, and Economic Growth in China. *Journal of Financial Economics , 77*, 57-116.

Berger, P. G., and Ofek, E. (1995). Diversification's Effect on Firm Value. *Journal of Financial Economics , 37*, 39-65.

Blanchard, O. (2006). Comments and Discussion. *Brookings Papers on Economic Activity , 2*, 89-92.

Blomström, M., Lipsey, R., and Zejan, M. (1996). Is Fixed Investment the Key to Economic Growth? *Quarterly Journal of Economics , 111* (1), 269-276.

Bond, S., and Van Reenen, J. (2007). Microeconometric Models of Investment and Employment. In *Handbook of Econometrics* (Vol. 6A, pp. 4418-4498). London: Elsevier B. V.

Bond, S., Elston, J. A., Mairesse, J., and Mulkay, B. (2003). Financial Factors and Investment in Belgium, France, Germany, and the United Kingdom: A Comparison Using Company Panel Data. *Review of Economics and Statistics , 85* (1), 153-165.

Brandt, L., Biesebroeck, J. V., and Zhang, Y. F. (2009). Creative Accounting or Creative Destruction? Firm-Level Productivity Growth in Chinese Manufacturing. *NBER Working Paper 15152* .

Brown, J., and Petersen, B. (2009). Why Has the Investment-Cash Flow Sensitivity Declined so Sharply? Rising R&D and Equity Market Developments. *Journal of Banking and Finance , 33*, 971-984.

Brown, J., Fazzari, S., and Petersen, B. (2009). Financing Innovation and Growth: Cash Flow, External Equity and the 1990s R&D Boom. *Journal of Finance*, *64*, 1, 151-85.

Carlier, G., and Renou, L. (2006). Debt Contracts with Ex-Ante and Ex-Post Asymmetric Information: An Example. *Economic Theory , 28*, 461-473.

Carlin, W., Fries, S., Schaffer, M., and Seabright, P. (2001). Competition and Enterprise Performance in Transition Economies: Evidence from a Cross-Country Survey. *Working Paper No. 376, Davidson Institute at the University of Michigan Business School* .

Carpenter, R. E., and Guariglia, A. (2008). Cash Flow, Investment, and Investment Opportunities: New Tests Using UK Panel Data. *Journal of Banking and Finance , 32*, 1894-1906.

Ding, S., and Knight, J. (2009). Can the Augmented Solow Model Explain China's Remarkable Economic Growth? A Cross-Country Panel Data Study. *Journal of Comparative Economics , 37* (3), 432-452.

Dollar, D., and Wei, S.-J. (2007). Das (Wasted) Capital: Firm Ownership and Investment Efficiency in China. *IMF Working Paper WP/07/9* .

Dougherty, S., and Herd, R. (2005). Fast Falling Barriers and Growing Concentration: the Emergence of a Private Economy in China. *OECD Economics Department Working Paper No. 471* .

Duchin, R., Ozbas, O., and B. Sensoy (2010). Costly External Finance, Corporate Investment, and the Subprime Mortgage Credit Crisis. *Journal of Financial Economics,* 97, 418-35.

Fazzari, S., Hubbard, G., and Petersen, B. (1988). Financing Constraints and Corporate Investment. *Brookings Papers on Economic Activity , 1*, 141-195.

Filatotchev, I., Isachenkova, N., and Michkiewicz, T. (2007). Ownership Structure and Investment Finance in Transition Economies. *Economics of Transition , 15* (3), 433-460.

Firth, M., Lin, C., and Wong, S. M. (2008). Leverage and Investment under a State-Owned Bank Lending Environment: Evidence from China. *Journal of Corporate Finance , 14*, 642-653.

Gadad, A.-M., and Thomas, H. M. (2004). Do Asset Sales Lead to Improvements in Operating Performance. *Applied Economics , 36*, 865-871.

Garnaut, R., Song, L., Tenev, S., and Yao, Y. (2005). *China's Ownership Transformation: Processes, Outcomes, Prospects.* Washington D.C.: World Bank.

Guariglia, A. (2007). Internal Financial Constraints, External Financial Constraints, and Investment Choice: Evidence from A Panel of UK Firms. *Journal of Banking and Finance , 32*, 1795-1809.

Guariglia, A., and Poncet, S. (2008). Could Financial Distortions be No Impediment to Economic Growth After All? Evidence from China. *Journal of Comparative Economics , 36* (4), 633-657.

Guariglia, A., Liu, X., and Song, L. (forthcoming). Internal Finance and Growth: Microeconometric Evidence on Chinese Firms. *Journal of Development Economics*.

Haggard, S., and Huang, Y. S. (2008). The Political Economy of Private-Sector Development in China. In L. Brandt, and T. G. Rawski, *China's Great Economic Transformation* (pp. 337-374). New York: Cambridge University Press.

Hite, G. L., Owers, J. E., and Rogers, R. C. (1987). The Market for Interfirm Asset Sales: Partial Sell-Offs and Total Liquidation. *Journal of Financial Economics , 18*, 229-252.

Hovakimian, G. (2009). Determinants of Investment Cash Flow Sensitivity. *Financial Management , Spring*, 161-183.

Hovakimian, G., and Titman, S. (2006). Corporate Investment with Financial Constraints: Sensitivity of Investment to Funds from Voluntary Asset Sales. *Journal of Money, Credit and Banking , 38* (2), 357-374.

Huang, Y. (2003). *Selling China: Foreign Direct Investment during the Reform Era.* New York: Cambridge University Press.

Hubbard, G. (1998). Capital Market Imperfections and Investment. *Journal of Economic Literature , 35*, 193-225.

Jensen, M. C. (1988). Agency Costs of Free Cash Flow, Corporate Finance, adn the Market for Takeovers. *American Economic Review , 76*, 323-329.

John, K., and Ofek, E. (1995). Asset Sales and Increase in Focus. *Journal of Financial Economics , 37*, 105-126.

Kaplan, S., and Zingales, L. (1997). Do Investment-Cash Flow Sensitivities Provide Useful Measures of Financing Constraints? *Quarterly Journal of Economics , 112*, 169-215.

Kaplan, S., and Zingales, L. (2000). Investment-Cash Flow Sensitivities are Not Valid Measures of Financing Constraints. *Quarterly Journal of Economics* , *115*, 707-712.

Knight, J., and Ding, S. (2010). Why does China Invest So Much? *Asian Economics Papers, 9 (3),* 86-116.

Kraay, A. (1999). Exports and Economic Performance: Evidence from A Panel of Chinese Enterprises. *Revue d'Economie Du Developpement , 1* (2), 183-207.

Lang, L., Ofek, E., and Stulz, R. M. (1996). Leverage, Investment and Firm Growth. *Journal of Financial Economics , 40*, 3-29.

Lang, L., Poulsen, A., and Stulz, R. (1995). Asset Sales, Firm Performance, and the Agency Costs of Managerial Discretion. *Journal of Financial Economics , 37*, 3-37.

Levinsohn, J., and Petrin, A. (2003). Estimating Production Functions Using Inputs to Control for Unobservables. *Review of Economic Studies , 70*, 317-341.

Lin, Y. F., and Zhu, T. (2001). Ownership Restructuring in Chinese State Industry: An Analysis of Evidence on Initial Organizational Changes. *China Quarterly , 166*, 298-334.

Liu, Q., and Xiao, G. (2004). Look who are Disguising Profits: An Application to Chinese Industrial Firms. *Mimeograph, University of Hong Kong* .

Lu, F., Song, G., Tang, J., Zhao, H., and Liu, L. (2008). Profitability of China's Industrial Firms (1978-2006). *China Economic Journal , 1* (1), 1-31.

Maksimovic, V., and Phillips, G. (2001). The Market for Corporate Assets: Who Engages in Mergers and Asset Sales and Are There Efficiency Gains? *Journal of Finance , 56* (6), 2019-2065.

McGuckin, R. H., and Nguyen, S. V. (1995). On Productivity and Plant Ownership Change: New Evidence from the LRD. *RAND Journal of Economics , 26*, 257-276.

Myers, S. C. (1977). Determinants of Corporate Borrowing. *Journal of Financial Economics , 5*, 147-175.

Myers, S. C. (1984). The Capital Structure Puzzle. *Journal of Finance , 34* (3), 572-592.

Myers, S. C., and Majluf, N. S. (1984). Corporate Financing and Investment Decisions When Firms Have Information that Investors Do Not Have. *Journal of Financial Economics , 13*, 187-221.

Naughton, B. (2007). *The Chinese Economy: Transitions and Growth.* Cambridge, MA: The MIT Press.

Oliner, S., and Rudebusch, G. (1992). Sources of the Financing Hierarchy for Business Investment. *Review of Economics and Statistics , 74*, 643-654.

Park, A., Yang, D., Shi, X. Z., and Jiang, Y. (forthcoming). Exporting and Firm Performance: Chinese Exporters and the Asian Financial Crisis. *Review of Economics and Statistics* .

Ravallion, M. and S. H. Chen. (2007). China's (Uneven) Progress Against Poverty. *Journal of Development Economics , 82*, 1-42.

Riedel, J., Jin, J. and J. Gao. (2007). *How China Grows: Investment, Finance and Reform.* Princeton: Princeton University Press.

Schlingemann, F. P., Stulz, R. M., and Walkling, R. A. (2002). Divestitures and the Liquidity of the Market for Corporate Assets. *Journal of Financial Economics , 64*, 117-144.

Shleifer, A., and Vishny, R. W. (1992). Liquidation Values and Debt Capacity: A Market Equilibrium Approach. *Journal of Finance , XLVII* (4), 1343-1366.

Stulz, R. M. (1990). Managerial Discretion and Optimal Financing Policies. *Journal of Financial Economics , 26*, 3-28.

Warusawitharana, M. (2008). Corporate Asset Purchases and Sales: Theory and Evidence. *Journal of Financial Economics , 87*, 471-497.

Wei, Z., Xie, F., and Zhang, S. (2005). Ownership Structure and Firm Value in China's Privatized Firms. *Journal of Financial and Quantitative Analysis , 40*, 87-108.

Wette, H. C. (1983). Collateral in Credit Rationing in Markets with Imperfect Information: Note. *American Economic Review , 73*, 442-445.

Table 1. Descriptive statistics of key variables

	Full sample	*SOEs*	*Collective firms*	*Private firms*	*Foreign firms*
Investment vs divestment					
fixed investment/tangible fixed assets	0.095	0.042	0.072	0.107	0.099
	(0.072)	(0.021)	(0.056)	(0.087)	(0.070)
negative investment ratio	0.314	0.407	0.343	0.303	0.291
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Independent variables in the baseline model					
cash flow	0.348	0.141	0.415	0.353	0.392
	(0.194)	(0.072)	(0.216)	(0.200)	(0.225)
leverage	0.578	0.632	0.592	0.597	0.485
	(0.592)	(0.643)	(0.605)	(0.615)	(0.482)
collateral	0.341	0.415	0.330	0.339	0.323
	(0.315)	(0.400)	(0.295)	(0.313)	(0.301)
TFP	3.340	2.893	2.996	3.129	4.644
	(2.259)	(1.768)	(2.088)	(2.143)	(3.019)
sales growth	0.116	0.060	0.083	0.131	0.112
	(0.108)	(0.060)	(0.081)	(0.121)	(0.104)
firm size	5.485	6.057	5.174	5.286	6.010
	(5.301)	(5.980)	(5.084)	(5.102)	(5.889)
firm age	2.114	3.070	2.589	1.960	1.988
	(2.079)	(3.401)	(2.639)	(1.946)	(2.079)
export	0.339	0.181	0.144	0.276	0.715
	(0.000)	(0.000)	(0.000)	(0.000)	(1.000)
Observations	639,361	48,689	52,427	399,072	113,469

Notes: mean and median (in parentheses) values of each variable are reported. The ownership classification is based on the majority rule. All variables are defined in Table A3 in Appendix 1.

Table 2. Baseline model -- random-effects probit estimation

	SOEs	*Collective firms*	*Private firms*	*Foreign firms*
$cash\ flow_{i,t-1}$	-0.221**	-0.156**	-0.114**	-0.081**
	(0.050)	(0.026)	(0.012)	(0.015)
	[-0.079]	[-0.055]	[-0.038]	[-0.026]
$leverage_{i,t-1}$	0.145**	-0.023	-0.175**	0.037
	(0.046)	(0.046)	(0.017)	(0.028)
	[0.052]		[-0.058]	
$collateral_{i,t-1}$	0.931**	0.773**	0.890**	0.765**
	(0.062)	(0.063)	(0.023)	(0.042)
	[0.335]	[0.271]	[0.299]	[0.249]
$TFP_{i,t-1}$	-0.057**	-0.039**	-0.032**	-0.019**
	(0.006)	(0.006)	(0.002)	(0.002)
	[-0.020]	[-0.014]	[-0.011]	[-0.006]
$sales\ growth_{i,t-1}$	-0.188**	-0.202**	-0.267**	-0.307**
	(0.027)	(0.028)	(0.009)	(0.016)
	[-0.067]	[-0.070]	[-0.089]	[-0.100]
$firm\ size_{i,t-1}$	-0.012	0.026**	0.012**	-0.008
	(0.010)	(0.012)	(0.004)	(0.007)
		[0.009]	[0.003]	
$firm\ age_{i,t}$	0.027**	0.032*	0.088**	0.171**
	(0.014)	(0.017)	(0.006)	(0.016)
	[0.010]	[0.011]	[0.029]	[0.055]
$export_{i,t}$	-0.007	-0.038	-0.123**	-0.155**
	(0.030)	(0.029)	(0.009)	(0.014)
			[-0.041]	[-0.051]
Pseudo-R^2	0.080	0.054	0.047	0.056
Observations	19,264	21,139	157,606	61,229

Note: the dependent variable is a binary variable which takes value of one if the firm divests, and zero otherwise. Heteroskedasticity-consistent standard errors are reported in parentheses. ** and * indicate significance at the 5 and 10 percent level respectively. Marginal effects are in square brackets for those variables that are statistically significant. Time dummies, industry dummies and their interactions are included in estimation but not reported. The ownership classification is based on the majority rule.

Table 3. Baseline model -- random-effects tobit estimation

	SOEs	*Collective firms*	*Private firms*	*Foreign firms*
$cash\ flow_{i,t-1}$	-0.082**	-0.099**	-0.065**	-0.043**
	(0.018)	(0.014)	(0.006)	(0.008)
	[-0.082]	[-0.099]	[-0.065]	[-0.043]
$leverage_{i,t-1}$	0.016	-0.068**	-0.126**	0.013
	(0.017)	(0.025)	(0.010)	(0.015)
		[-0.068]	[-0.126]	
$collateral_{i,t-1}$	0.294**	0.450**	0.574**	0.481**
	(0.026)	(0.038)	(0.015)	(0.026)
	[0.294]	[0.450]	[0.574]	[0.481]
$TFP_{i,t-1}$	-0.019**	-0.018**	-0.017**	-0.010**
	(0.002)	(0.004)	(0.001)	(0.001)
	[-0.019]	[-0.018]	[-0.017]	[-0.010]
$sales\ growth_{i,t-1}$	-0.044**	-0.064**	-0.118**	-0.136**
	(0.010)	(0.017)	(0.007)	(0.011)
	[-0.044]	[-0.064]	[-0.118]	[-0.136]
$firm\ size_{i,t-1}$	-0.003	0.016**	0.008**	-0.015**
	(0.004)	(0.007)	(0.003)	(0.003)
		[0.016]	[0.008]	[-0.015]
$firm\ age_{i,t}$	0.003	0.013	0.044**	0.104**
	(0.005)	(0.009)	(0.003)	(0.009)
			[0.044]	[0.104]
$export_{i,t}$	0.007	-0.005	-0.061**	-0.079**
	(0.012)	(0.018)	(0.005)	(0.008)
			[-0.061]	[-0.079]
Pseudo-R^2	0.054	0.038	0.035	0.044
Observations	19,264	21,139	157,606	61,229

Note: the dependent variable is a censored variable which is equal to zero if the firm does not divest, and takes the value of the actual amount of divestment otherwise. Also see Notes to Table 2.

Table 4. Descriptive statistics of variables used in the robustness tests

	Full sample	*SOEs*	*Collective firms*	*Private firms*	*Foreign firms*
Financing variable					
profit	0.234	0.059	0.299	0.242	0.251
	(0.082)	(0.009)	(0.101)	(0.092)	(0.090)
Efficiency variables					
value added per worker	0.701	0.470	0.629	0.696	0.839
	(0.408)	(0.231)	(0.357)	(0.428)	(0.442)
productivity	2.669	1.549	2.364	2.657	3.291
	(1.684)	(0.814)	(1.438)	(1.740)	(2.040)
Growth variables					
value added growth	0.111	0.036	0.062	0.126	0.121
	(0.098)	(0.043)	(0.058)	(0.110)	(0.104)
asset growth	0.086	0.017	0.051	0.106	0.075
	(0.046)	(-0.001)	(0.018)	(0.063)	(0.047)
employment growth	0.017	-0.041	-0.011	0.021	0.049
	(0.000)	(-0.013)	(0.000)	(0.000)	(0.008)
TFP growth	0.090	0.044	0.060	0.098	0.097
	(0.080)	(0.046)	(0.059)	(0.087)	(0.085)
Conditioning variable					
export ratio	0.196	0.045	0.068	0.147	0.495
	(0.000)	(0.000)	(0.000)	(0.000)	(0.519)
Observations	639,361	48,689	52,427	399,072	113,469

Note: See Notes to Table 1.

Table 5. Robustness tests – alternative measures of hypotheses (random-effects probit estimation)

	SOEs	*Collective firms*	*Private firms*	*Foreign firms*
Financing variable (Model 2)				
$profit_{i,t-1}$	-0.190**	-0.109**	-0.071**	-0.057**
	(0.051)	(0.026)	(0.011)	(0.015)
	[-0.069]	[-0.038]	[-0.024]	[-0.018]
Pseudo-R^2	0.079	0.054	0.047	0.056
Observations	19,264	21,139	157,606	61,229
Efficiency variables (Model 3)				
$value\ added\ per\ worker_{i,t-1}$	-0.065**	-0.003	0.018**	0.017**
	(0.017)	(0.015)	(0.004)	(0.006)
	[-0.023]		[0.006]	[0.005]
Pseudo-R^2	0.085	0.053	0.047	0.057
Observations	23,739	21,709	163,095	65,815
$productivity_{i,t-1}$	-0.015**	0.008* (0.005)	0.013**	0.017**
	(0.006)	[0.003]	(0.002)	(0.002)
	[-0.005]		[0.004]	[0.006]
Pseudo-R^2	0.085	0.053	0.046	0.058
Observations	23,739	21,709	163,095	65,815
Growth variables (Model 4)				
$value\ added\ growth_{i,t-1}$	-0.001	-0.022	-0.101**	-0.082**
	(0.016)	(0.019)	(0.007)	(0.010)
			[-0.034]	[-0.027]
Pseudo-R^2	0.081	0.053	0.044	0.052
Observations	16,468	18,968	148,823	55,385
$asset\ growth_{i,t-1}$	-0.457**	-0.171**	-0.318**	-0.268**
	(0.050)	(0.040)	(0.013)	(0.022)
	[-0.164]	[-0.059]	[-0.107]	[-0.087]
Pseudo-R^2	0.082	0.053	0.047	0.054
Observations	19,277	21,142	157,632	61,220
$employment\ growth_{i,t-1}$	-0.209**	-0.272**	-0.322**	-0.396**
	(0.042)	(0.037)	(0.012)	(0.021)
	[-0.076]	[-0.095]	[-0.107]	[-0.129]
Pseudo-R^2	0.079	0.054	0.047	0.057
Observations	19,246	21,127	157,550	61,183
$TFP\ growth_{i,t-1}$	0.005	-0.009 (0.020)	-0.068**	-0.050**
	(0.019)		(0.007)	(0.010)
			[-0.023]	[-0.017]
Pseudo-R^2	0.081	0.053	0.043	0.051
Observations	15,500	18,186	142,208	51,665
Conditioning variable (Model 5)				
$export\ ratio_{i,t-1}$	0.067	-0.016 (0.046)	-0.139**	-0.153**
	(0.065)		(0.013)	(0.015)
			[-0.047]	[-.049]
Pseudo-R^2	0.080	0.054	0.047	0.056
Observations	19,264	21,139	157,606	61,229

Notes: For each model, we only report the results of the new variable to save space. Also se Notes to Table 2.

Table 6. Robustness tests – instrumental variable method (random-effects probit estimation)

	SOEs	*Collective firms*	*Private firms*	*Foreign firms*
$cash\ flow_{i,t-1}$	-0.344**	-0.183**	-0.147**	-0.135**
	(0.117)	(0.062)	(0.035)	(0.048)
	[-0.344]	[-0.183]	[-0.147]	[-0.135]
$leverage_{i,t-1}$	0.222**	-0.026	-0.214**	0.052
	(0.061)	(0.062)	(0.025)	(0.038)
	[0.222]		[-0.214]	
$collateral_{i,t-1}$	0.806**	0.622**	0.604**	0.536**
	(0.091)	(0.086)	(0.039)	(0.075)
	[0.806]	[0.622]	[0.604]	[0.536]
$TFP_{i,t-1}$	-0.073**	-0.048**	-0.038**	-0.020**
	(0.008)	(0.010)	(0.004)	(0.004)
	[-0.073]	[-0.048]	[-0.038]	[-0.020]
$sales\ growth_{i,t-1}$	-0.201**	-0.193**	-0.276**	-0.324**
	(0.038)	(0.034)	(0.012)	(0.022)
	[-0.201]	[-0.193]	[-0.276]	[-0.324]
$firm\ size_{i,t-1}$	0.012	0.029	0.025**	-0.005
	(0.014)	(0.018)	(0.007)	(0.011)
			[0.025]	
$firm\ age_{i,t}$	0.014	0.016	0.073**	0.138**
	(0.017)	(0.019)	(0.006)	(0.019)
			[0.073]	[0.138]
$export_{i,t}$	-0.033	0.005	-0.131**	-0.155**
	(0.034)	(0.032)	(0.009)	(0.015)
			[-0.131]	[-0.155]
Wald test of exogeneity	89.67	25.80	357.96	67.02
	{0.000}	{0.000}	{0.000}	{0.000}
Observations	12,483	14,654	112,695	42,614

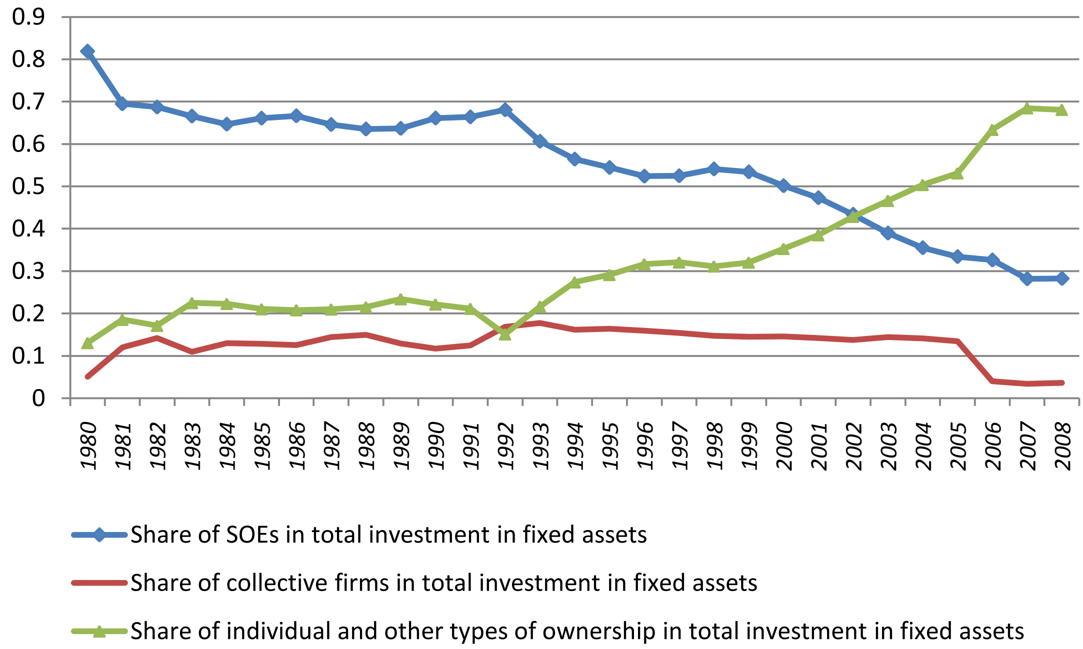
Notes: p values of the Wald test of exogeneity are shown in curly brackets. Also see Notes to Table 2.

Table 7. Robustness tests – interactions (probit estimation)

	SOEs	*Collective firms*	*Private firms*	*Foreign firms*
cash flow				
$cash\ flow_{i,t-1} * LOWCF_{i,t-1}$	-0.425**	-0.348**	-0.485**	-0.111**
	(0.083)	(0.078)	(0.035)	(0.029)
	[-0.153]	[-0.122]	[-0.162]	[-0.036]
$cash\ flow_{i,t-1} * HIGHCF_{i,t-1}$	-0.173**	-0.149**	-0.095**	-0.077**
	(0.052)	(0.026)	(0.011)	(0.015)
	[-0.062]	[-0.052]	[-0.032]	[-0.025]
χ^2 test for $H_0: \beta_1 = \beta_2$	8.51	7.47	137.77	1.37
	{0.003}	{0.006}	{0.000}	{0.242}
leverage				
$leverage_{i,t-1} * LOWLEVERAGE_{i,t-1}$	0.045	-0.068	-0.255**	-0.029
	(0.078)	(0.070)	(0.025)	(0.038)
			[-0.085]	
$leverage_{i,t-1} * HIGHLEVERAGE_{i,t-1}$	0.116**	-0.034	-0.193**	0.032
	(0.049)	(0.047)	(0.017)	(0.028)
	[0.042]		[-0.065]	
χ^2 test for $H_0: \beta_1 = \beta_2$	2.43	0.69	17.69	5.95
	{0.118}	{0.405}	{0.000}	{0.014}
collateral				
$collateral_{i,t-1} * LOWCOLLATERAL_{i,t-1}$	3.461**	3.095**	3.346**	2.887**
	(0.136)	(0.121)	(0.042)	(0.070)
	[1.219]	[1.057]	[1.086]	[0.919]
$collateral_{i,t-1} * HIGHCOLLATERAL_{i,t-1}$	1.541**	1.222**	1.374**	1.207**
	(0.070)	(0.068)	(0.025)	(0.044)
	[0.543]	[0.417]	[0.446]	[0.384]
χ^2 test for $H_0: \beta_1 = \beta_2$	449.51	518.54	5089.08	1418.81
	{0.000}	{0.000}	{0.000}	{0.000}
TFP				
$TFP_{i,t-1} * LOWTFP_{i,t-1}$	0.015	0.013	0.027**	0.058**
	(0.010)	(0.011)	(0.004)	(0.005)
			[0.009]	[0.019]
$TFP_{i,t-1} * HIGHTFP_{i,t-1}$	-0.045**	-0.038**	-0.028**	-0.015**
	(0.005)	(0.006)	(0.002)	(0.002)
	[-0.016]	[-0.013]	[-0.009]	[-0.004]
χ^2 test for $H_0: \beta_1 = \beta_2$	45.15	32.95	259.86	201.31
	{0.000}	{0.000}	{0.000}	{0.000}
sales growth				
$sale\ growth_{i,t-1} * LOWSALESGROWTH_{i,t-1}$	-0.129**	-0.124**	-0.109**	-0.176**
	(0.036)	(0.038)	(0.013)	(0.022)
	[-0.046]	[-0.043]	[-0.036]	[-0.057]
$sale\ growth_{i,t-1} * HIGHSALESGROWTH_{i,t-1}$	-0.259**	-0.279**	-0.403**	-0.434**
	(0.040)	(0.038)	(0.012)	(0.022)
	[-0.093]	[-0.097]	[-0.135]	[-0.141]
χ^2 test for $H_0: \beta_1 = \beta_2$	5.80	8.75	271.02	72.48
	{0.016}	{0.003}	{0.000}	{0.000}
Observations	19,264	21,139	157,606	61,229

Notes: $LOW(X)_{i,t}$ is a dummy variable equal to 1 if firm *i*'s variable *X* at time *t* is in the bottom half of the distribution of that variable, and 0 otherwise. $HIGH(X)_{i,t}$ is a dummy variable equal to 1 if firm *i*'s variable *X* at time *t* is in the top half of the distribution of that variable, and 0 otherwise. For each model, we only report the coefficients associated with the new variables to save space. *p* values of the χ^2 test for the hypothesis that the coefficients of the two variables are the same are in curly brackets. Also see Notes to Table 2.

Figure 1. Share of firms owned by different agents in total investment in fixed assets



Data source: NBS *Statistical Yearbook* (Various issues). Notes: individual firms include family farms and small private businesses; other types of ownership consist of joint-ownership enterprises, shareholding companies, joint-venture enterprises, and foreign firms.

Appendix 1

Table A1. Structure of our unbalanced panel

Panel I

Year	*Number of observations*	*Percent*	*Cumulative*
2000	49,639	7.76	7.76
2001	66,241	10.36	18.12
2002	78,640	12.30	30.42
2003	93,330	14.60	45.02
2004	92,291	14.43	59.45
2005	91,147	14.26	73.71
2006	87,147	13.63	87.34
2007	80,947	12.66	100.00
Total	639,382	100.00	

Panel II

Number of obs. per firm	*Number of observations*	*Percent*	*Cumulative*
5	154,645	24.19	24.19
6	140,316	21.95	46.13
7	153,685	24.04	70.17
8	190,736	29.83	100.00
Total	639,382	100.00	

Table A2. Distribution of observations by ownership

Panel I. By the majority rule

	SOEs	*Collective firms*	*Private firms*	*Foreign firms*	*Mixed ownership*	*Total*
2000	11.80	11.06	52.04	19.49	5.61	100.00
2001	9.49	9.62	58.00	18.20	4.69	100.00
2002	8.65	8.90	60.89	17.23	4.33	100.00
2003	7.57	8.04	63.36	17.25	3.77	100.00
2004	7.36	7.83	63.56	17.53	3.71	100.00
2005	6.75	7.62	64.42	17.47	3.73	100.00
2006	6.27	7.21	65.18	17.69	3.65	100.00
2007	5.28	6.93	66.25	17.99	3.55	100.00
Average	7.62	8.20	62.42	17.75	4.02	100.00

Note: all numbers in this table are in percentage terms.

Panel II. By the 100% rule

	SOEs	*Collective firms*	*Private firms*	*Foreign firms*	*Mixed ownership*	*Total*
2000	5.89	3.58	23.53	10.54	56.45	100.00
2001	4.75	3.13	31.18	10.04	50.90	100.00
2002	4.27	2.96	35.43	9.62	47.73	100.00
2003	3.71	2.71	39.57	9.96	44.05	100.00
2004	3.68	2.69	40.00	10.21	43.41	100.00
2005	3.25	2.57	40.52	10.21	43.45	100.00
2006	2.95	2.40	41.14	10.39	43.13	100.00
2007	2.23	2.27	42.04	10.62	42.85	100.00
Average	3.69	2.73	37.67	10.18	45.72	100.00

Note: all numbers in this table are in percentage terms.

Table A3. Variable definitions

Variables	*Definitions*
Dependent variable in the probit model	
divestment	Binary variable which takes value of one if the firm divests (ik<0), and zero otherwise. ik is the ratio of fixed investment to tangible fixed assets, where fixed investment is defined as the difference between the book value of tangible fixed assets of end of year *t* and end of year *t*-1, adding depreciation of year *t*.
Dependent variable in the tobit model	
divestment	Censored variable equal to zero if the firm does not divest (ik>=0), and equal to the actual value of the divestment otherwise.
Independent variables (in both the baseline model and robustness tests)	
Financing variables	
cash flow	Cash flow divided by total tangible fixed assets. Cash flow is defined as the sum of the firm's net income and depreciation.
leverage	Total debt divided by total assets.
collateral	Tangible fixed assets divided by total assets.
profit	Net income divided by total tangible fixed asset.
Efficiency variables	
TFP	Total factor productivity calculated using the Levinsohn and Petrin (2003) method.
value added per worker	Real value added divided by the number of employees.
productivity	Average labour productivity: real sales divided by the number of employees.
Growth variables	
sales growth	Growth rate of real sales
value added growth	Growth rate of value added
asset growth	Growth rate of total real assets
employment growth	Growth rate of number of employees
TFP growth	Growth rate of TFP
Conditioning variables	
firm size	Natural logarithm of the book value of total real assets.
firm age	Natural logarithm of firm age
export	Dummy variable equal to one if the firm exports, and zero otherwise.
export ratio	Ratio of exports over total real sales.

Note: all variables (except dummy variables) are deflated using provincial ex-factory producer price indices taken from various issues of the *China Statistical Yearbook*.

Appendix 2

Procedure to construct TFP

A key issue in the estimation of production functions is the correlation between unobservable productivity shocks and input levels (Levinsohn and Petrin, 2003). Profit-maximizing firms respond to positive productivity shocks by expanding output, which requires additional inputs. Negative shocks lead firms to pare back output, decreasing their input usage. Methods that ignore this endogeneity, such as OLS and the fixed-effects estimator, will provide inconsistent estimates of the parameters of the production function. In this paper, we follow the approach of Levinsohn and Petrin (2003) which uses intermediate inputs as a proxy for unobservable shocks.

We assume a simple two-factor production function of the form:

$$Y_{it} = A_{it} L_{it}^{\beta} K_{it}^{\gamma} \qquad \text{(A1)}$$

where Y_{it} is a measure of output such as gross revenue or value added, and L_{it} and K_{it} represent the usage of labour and capital, respectively. A_{it} is total factor productivity (TFP) which increases all factors' marginal products simultaneously. Transforming equation (A1) into logarithms allows linear estimation. Henceforth small letters will be used for logs. A simple standard estimation equation of the production function then looks as follows:

$$y_{it} = \beta . l_{it} + \gamma . k_{it} + u_{it} \qquad \text{(A2)}$$

The residual of this equation is the logarithm of plant-specific TFP, namely A_{it}.The simultaneity problem is that at least a part of TFP will be observed by the firm at a point in time early enough so as to allow the firm to change the factor input decision. For any profit-maximizing firm, the realization of the error term of the production function is expected to influence the choice of factor inputs. To deal with the correlation between the regressors and the error term, Levinsohn and Petrin (2003) estimate the following production function

$$y_{it} = \beta_0 + \beta_l . l_{it} + \beta_k . k_{it} + \beta_m . m_{it} + \omega_{it} + \eta_{it} \qquad \text{(A3)}$$

where y_{it} is the logarithm of the firm's output; l_{it} and m_{it} are the logarithm of the freely variable labour and intermediate inputs; and k_{it} is the logarithm of the state variable capital. The error term has two components: the transmitted productivity component given by ω_{it}, and an independent and identically-distributed component, which is uncorrelated with input choice, η_{it}. The key difference between ω_{it} and η_{it} is that the former is a state variable and hence impacts the firm's decision rules, while the latter has no impact on the firm's decisions.

Demand for the intermediate input m_{it} is assumed to depend on the firm's state variables k_{it} and ω_{it} : $m_{it} = m_{it}(k_{it}, \omega_{it})$. Making mild assumptions about the firm's production technology, Levinsohn and Petrin (2003) show that this demand function is monotonically increasing in ω_{it} . This allows the inversion of the intermediate demand function, which leads to: $\omega_{it} = \omega_{it}\ (k_{it}, m_{it})$. The unobservable productivity term is now expressed solely as a function of two observed inputs. Besides, Levinsohn and Petrin (2003) assume that productivity is governed by a first-order Markov process, i.e. $\omega_{it} = E\left[\omega_{it}\middle|\omega_{i,t-1}\right] + \varepsilon_{it}$, where ε_{it} is an innovation to productivity that is uncorrelated with k_{it}, but not necessarily with l_{it}. This is part of the source of the simultaneity problem. Equation (A3) can therefore be expressed as

$$y_{it} = \beta_l . l_{it} + \phi_t(k_{it}, m_{it}) + \eta_{it} \qquad \text{(A4)}$$

where $\phi_{it}(k_{it}, m_{it}) = \beta_0 + \beta_k . k_{it} + \beta_m . m_{it} + \omega_{it}(k_{it}, m_{it})$. Levinsohn and Petrin (2003) approximate $\phi_t(k_{it}, m_{it})$ by a third-order polynomial in k and m, $\sum_{j=0}^{3} \sum_{s}^{3} \delta_{js} k_{it}^{j}\ m_{it}^{s}$, and obtain an estimate of β_l and $\phi_t$via OLS. This constitutes the first stage of their estimation procedure.

In the second stage, the elasticity of capital β_k is defined as the solution to the following problem:$\min_{\beta_k^*} \sum_i \sum_t (y_{it} - \widehat{\beta_l} . l_{it} - {\beta_k}^* . k_{it} - \varpi_{it})^2$, where ϖ_{it} is a nonparametric approximation of $E\left[\omega_{it}\middle|\omega_{i,t-1}\right]$. Since the estimator involves two stages, the calculation of the covariance matrix of the parameters is quite involved. Levinsohn and Petrin (2003) suggest therefore the use of a bootstrapping procedure to estimate standard errors. Once consistent estimates of the input elasticities are derived, the log of productivity can be obtained as $\widehat{\omega_{it}} = y_{it} - \widehat{\beta_l} . l_{it} - \widehat{\beta_k} . k_{it}$. TFP estimates based on the Levinsohn and Petrin (2003) method can be obtained in STATA by using the *levpet* command.